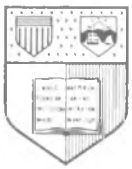

Cornell
University

ANNOUNCEMENTS

Graduate School of *Medical Sciences*

1967-68

Cornell University

Graduate School of Medical Sciences

1967-68

1300 York Avenue
New York, New York 10021
Telephone: TRafalgar 9-9000

Calendar*

FALL SEMESTER	1967–68
Registration	Sept. 8 & 11
Opening Exercises, 3:30 P.M.	Sept. 11
Instruction begins for first trimester and fall semester	Sept. 12
Thanksgiving Day, holiday	Nov. 23
End of first trimester	Nov. 25
Examinations for first trimester	Nov. 27–Dec. 2
Instruction begins for second trimester	Dec. 4
Christmas recess: Instruction ends, 1:00 P.M.	Dec. 16
Instruction resumes at 9:00 A.M.	Jan. 2
Last day for completing all requirements for February degrees	Jan. 19
Fall semester ends	Jan. 31

SPRING SEMESTER	
Registration	Feb. 1 & 2
Instruction begins for spring semester	Feb. 5
End of second trimester	Mar. 2
Examinations for second trimester	Mar. 4–16
Instruction begins for third trimester	Mar. 18
Spring recess: Instruction ends, 1:00 P.M.	Apr. 14
Instruction resumes at 9:00 A.M.	Apr. 21
Last day for completing all requirements for June degrees	May 10
Memorial Day, holiday	May 30
Commencement, 3:00 P.M.	June 5
End of third trimester and spring semester	June 8
Examinations for third trimester	June 10 & 11

SUMMER	
Summer research period begins	June 5
Registration for summer research	June 5
Last day for completing all requirements for September degrees	Aug. 16
Labor Day, holiday	Sept. 2
Summer research period ends	Sept. 6

* Courses in the Graduate School of Medical Sciences are either semestral or trimestral. The calendar for this School is based primarily on the academic semester but is coordinated as well with the trimestral calendar of the Medical College.

Contents

The courses and curricula described in this Announcement, and the teaching personnel listed therein, are subject to change at any time by official action of Cornell University.

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Martin Sonenberg

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FACULTY

Emeritus Professors

McKeen Cattell, M.D., Professor of Pharmacology, Cornell University Medical College.

Gilbert Dalldorf, M.D., Professor of Pathology, Sloan-Kettering Division.

Vincent du Vigneaud, Ph.D., Professor of Biochemistry, Cornell University Medical College.

Dayton J. Edwards, Ph.D., Professor of Physiology, Cornell University Medical College.

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Joseph C. Hinsey, Ph.D., Professor of Neuroanatomy, Cornell University Medical College.

Charles V. Morrill, Ph.D., Professor of Anatomy, Cornell University Medical College.

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Fred W. Stewart, M.D., Professor of Pathology, Sloan-Kettering Division.

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Cornell University

GRADUATE SCHOOL OF MEDICAL SCIENCES

PURPOSE AND NATURE OF GRADUATE STUDY

The Graduate School of Medical Sciences of Cornell University offers facilities for advanced study and research for students desiring a comprehensive view of certain areas of knowledge and training for investigation in various specific Fields. The faculty of the School requires of all candidates for advanced degrees a period of study in residence, advanced competence in some one subject, and adequate introduction to allied subjects, as well as the successful completion of stipulated language, qualifying, and final examinations.

The Graduate School of Medical Sciences offers curricula leading to the degree of Doctor of Philosophy in the Fields of Anatomy, Biochemistry, Biology, Biomathematics, Biophysics, Biostatistics, Cell Biology, Genetics, Microbiology, Neurobiology and Behavior, Pathology, Pharmacology, and Physiology, and to the Master of Science degree in certain of these Fields. Cornell University has a strong commitment to doctoral work, and the philosophy of the Graduate School of Medical Sciences in consonant with that of Cornell in this matter. The School does, however, recognize the need and a place for the Master's degree in certain Fields.

The degree of Doctor of Philosophy is granted not only as a result of the fulfillment of certain technical requirements such as residence study or satisfactory completion of graduate courses, but it bespeaks as well the development and possession of a critical and creative ability in science and of a fruitful expression of the imagination. Evidence of the latter is given in the

dissertation that the candidate prepares and which constitutes an original research contribution to the area of knowledge chosen for study.

GRADUATE SCHOOL HISTORY

Graduate work leading to an advanced general degree has continued to occupy a place in the Medical College since 1912 when it was offered in a cooperative arrangement with the Graduate School of Cornell University. Under the plan as originally announced, students registered for an advanced degree in the Medical College, but in all respects they were subject to the rules and regulations prevailing at the University. The departments offering graduate instruction were identified in the first announcement as the "scientific departments."

In June, 1950, the trustees of Cornell University entered into an agreement with the Sloan-Kettering Institute for Cancer Research whereby a new division of the Medical College, namely, the Sloan-Kettering Division, was created for the purpose of offering additional opportunities for graduate study toward advanced degrees, thus extending the areas of the basic sciences. This expansion of the New York City component of the Graduate School prompted the faculty of the University's Graduate School to give consideration to matters of administration, with the result that, by action of the trustees in January, 1952, the Graduate School of Medical Sciences was established, which, with the approval of the Graduate Faculty of Cornell University, "shall have full responsibility for advanced and professional degrees granted for study in residence at the New York City campus of Cornell University."

FACILITIES

THE MEDICAL COLLEGE. The buildings of the Medical College extending along York Avenue from 68th to 70th Streets contain the main library, the lecture rooms and study laboratories for the basic science departments, and the extensive research facilities for staff and students in the Fields of Anatomy, Biochemistry, Microbiology, Pathology, Pharmacology, and Physiology.

THE SLOAN-KETTERING DIVISION. The facilities of the Sloan-Kettering Division consist of the Howard Laboratory and the Kettering Laboratory on East 68th Street in New York City,

and the Walker Laboratory in Rye, New York. Collectively, these facilities represent the Sloan-Kettering Institute for Cancer Research. The special facilities and staff of experienced investigators of the Sloan-Kettering Division provide ample opportunities for advanced training in Biochemistry, Biology, and Biophysics.

ORGANIZATION OF THE SCHOOL

The Deans

The Dean of the Medical College, who holds the additional title of Associate Dean of the Graduate School of Medical Sciences, is the administrative head. He reports annually to the Graduate Faculty of Cornell University for approval of the activities of the Graduate School of Medical Sciences.

The Assistant Dean of the Graduate School of Medical Sciences aids the Associate Dean in the fulfillment of his responsibilities.

The Faculty

The faculty includes the professors, associate professors, and assistant professors who are engaged in research and study in the Fields of biomedical sciences in which graduate study is offered and who by interest and availability of time are able to sponsor graduate students. Some instructors and research associates holding the degree of Ph.D., who are needed by a particular Field, are eligible for inclusion in the faculty and may act as representatives for minor subjects on Special Committees of graduate students.

The Committee of the School

The Committee of the Graduate School of Medical Sciences is both an administrative and judicial board. The Committee considers matters referred to it by the faculty or by members of the faculty and may on its own initiative make recommendations to the faculty on any matters concerning the interests or policies of the Graduate School of Medical Sciences.

The Assistant Dean serves as chairman of this Committee with four members of the graduate faculty. Two members of the Committee represent the faculty of the Sloan-Kettering Division and the remaining two members are chosen from the faculty in the basic science fields of the Medical College. The faculty

members of the Committee are nominated by the Associate Dean and appointed annually by the President of the University.

The Committee serves as an agency for: (1) approval and administration of the admission of students, (2) approval of major and minor subjects, (3) allotment of units of credit toward advanced degrees, and (4) student discipline.

Basic Science Faculty Council

This Council is composed of representatives from each of the Fields of graduate study. The Dean of the Medical College, who is also the Associate Dean of the Graduate School of Medical Sciences, is an ex officio member. The principal purposes of the Council are to serve as a forum for exchange of ideas on graduate education and to make recommendations on matters of admission, curriculum, and degree requirements. No less important is its concern with the education of medical students and medical postgraduates in the biomedical sciences. Accordingly, the Basic Science Faculty Council interacts with the Executive Faculty and the Clinical Science Faculty Council of the Medical College to foster medical education in the broadest sense.

ADMISSION

For admission to the Graduate School of Medical Sciences, an applicant (1) must have a baccalaureate degree or the equivalent from a college or university of recognized standing, (2) must have adequate preparation in the chosen Field of instruction, and (3) as judged by his previous record, must show promise of ability to pursue advanced study and research.

Applicants may be admitted in September, February, or July. All credentials must be submitted at least three months prior to planned admission.

Application for admission is to be made on special forms obtainable from the Office of the Graduate School of Medical Sciences, Cornell University Medical College, 1300 York Avenue, New York, N. Y. 10021. The completed application is to be returned to the School. The applicant is required to support his application for admission with two letters of recommendation from individuals in academic pursuits who know the applicant personally, and with official transcripts of record from all the colleges and universities attended by the applicant. The applicant must arrange to have the supporting credentials forwarded to the Office of the Graduate School of Medical Sciences.

Before formal application is submitted, it may be advisable for a prospective applicant to confer, either in person or by writing, with a member of the faculty in a major discipline in either the Medical College or the Sloan-Kettering Division, in order to obtain the faculty member's consent to sponsor and plan the applicant's program. In consultation with other faculty members who teach in the student's minor Fields, the sponsor organizes and acts as chairman of the faculty group, the student's Special Committee.

When application for admission is made without prior consultation with a member of the faculty, the student who is accepted will be assigned a temporary major sponsor.

Scores made in the Graduate Record Examination, although not required, will prove helpful in determining the acceptability of the applicant. Students who plan to take this examination should communicate directly with the Educational Testing Service, Princeton, New Jersey 08540.

Proficiency tests to examine the student's background in any or all of the basic sciences presented as preparation for the Fields constituting any candidate's major and minor subjects may be required at the discretion of the candidate's major sponsor. The tests are given a few days before initial registration. Each test will cover material normally presented in undergraduate courses in those sciences. The results of these tests will be used to aid the candidate's Special Committee in planning his course of study. While the results of these tests will not be considered in the usual sense of "passing" or "failing," low marks in one or more of the tests may require a preponderance of elementary courses.

A student is admitted to the Graduate School when a formal notice of acceptance has been issued by the Associate Dean of the Graduate School of Medical Sciences. If the candidate is accepted with conditions, these will be recorded in the notice of admission.

Provisional Candidacy

Under circumstances in which it is difficult to evaluate the academic background of qualified applicants, they may be admitted to *provisional* candidacy. Such status is often appropriate to the foreign student. Ordinarily only one semester of study in provisional candidacy is permitted, and the student who fails to qualify for candidacy at the end of that time may be requested to withdraw from the Graduate School of Medical Sciences. In any event, no more than two semesters of study in provisional candidacy are permitted, and of these no more than

one may be considered as applicable to the residence requirement for a degree.

Special Students

All students not registered in Cornell University Graduate School and not registered for the M.D. degree are Special Students.

Such students are *Special Students* in the true sense of the word and must be especially qualified in preparation, ability, and objective in order to receive any consideration. They may or may not be graduate students in the sense of having completed work for a collegiate degree.

Special students are admitted *only by the consent of the head of the department,* must be registered in the Administration Office of the Medical College, and must pay their fees at the Business Office before being admitted to lectures or laboratory exercises.

Change of Status

A student who wishes to change from one degree or field to another, or who, after receiving the Master's degree, wishes to undertake candidacy for the doctorate, must submit a written request to the Office of the Graduate School of Medical Sciences asking for transfer to the new status, and giving reasons for the requested change. Provisional candidacy is automatically reviewed at the end of each semester, and no letter is necessary.

REGISTRATION

All students must register in the Office of the Graduate School of Medical Sciences at the beginning of the fall and spring semesters and the summer research period. It is expected that students who matriculate will continue for the full academic year (commencing in September and terminating with the end of the summer research period). Should circumstances require attendance for less than a year, special arrangements may be made for registering for one semester. A graduate student who has completed the residence requirements for his degree and who remains in residence while working on his thesis or while doing other work in preparation for a degree must register each semester in which he is so engaged.

A graduate student who discontinues his work during a semester in which he is registered should immediately report this

fact to the Office of the Graduate School of Medical Sciences in order to obtain an official withdrawal or an honorable dismissal.

MAJOR AND MINOR SUBJECTS

Approved major and minor subjects for the curriculum of a candidate for an advanced degree are listed below as separate Fields of instruction.

A candidate for the Ph.D. degree is required to register for one major and two minor subjects. For any Ph.D. candidate, a Field may secure permission from the Committee of the Graduate School of Medical Sciences to require only one minor subject. If a student in a Ph.D. program is to study a single minor subject, the third member of his Special Committee (see below) will be chosen from the faculty of the Graduate School of Medical Sciences in general.

The curriculum of a candidate for the M.S. degree consists of a major and one minor subject.

Candidates are urged to minor in a Field other than the one in which they major.

SPECIAL COMMITTEES

Special Committees are the means for directing individual candidates in the attainment of that independence implicit in advanced degrees. A candidate's Special Committee consists of three members of the faculty. The candidate's major sponsor, who represents the Field of the major subject in the Special Committee, serves as the chairman. The candidate, with the advice of his major sponsor, selects the two remaining members of his Special Committee from the faculty in the Fields of his minor subjects. Any faculty member is eligible to serve on these committees, but the chairman must be of professorial rank. An instructor may serve on a Special Committee as representative for a minor subject. On the recommendation of the major sponsor and with the approval of the Associate Dean, when a minor subject essential to the candidate's graduate program is not represented in the Graduate School of Medical Sciences, a faculty member of another university may be selected to represent this minor subject as an *ad hoc* member of the Special Committee.

The members selected indicate their willingness to serve by signing the record of major and minor subjects, which is filed with the Office of the Graduate School of Medical Sciences.

There are no regulations of the Graduate faculty on the content of instruction or courses to which the Special Committee must

subscribe. The Special Committee (or the major sponsor, in the absence of an established Special Committee) is required, however, to evaluate the candidate's academic background within a few weeks after his admission to the School and to plan on the basis of this evaluation the candidate's program for the first year of graduate study. The Special Committee may impose any requirements that it deems necessary over and above the general requirements for the School and of the Fields of the major and minor subjects.

Members of the Special Committee instruct or supervise the instruction of a candidate, judge whether the student's progress is satisfactory, conduct qualifying and final examinations, and approve the thesis. The chairman prepares reports on grades in formal courses and performance in research and makes requests for qualifying and final examinations. Although the members of the Special Committee are the candidate's advisers, it is the responsibility of the candidate himself to become familiar with the various regulations that apply to his case and to satisfy them in the proper way.

RESIDENCE REQUIREMENTS

The faculty requires of each candidate for a Master's degree a minimum of two residence units. Candidates for a Master's degree who receive fellowships must complete all requirements for the degree within two years of initial registration. For the doctorate, a minimum of six residence units is required. One residence unit represents one academic semester of full-time study or research toward the doctoral thesis.

No residence unit or fraction is granted in fulfillment of the requirements for the Master's degree for study outside the Graduate School. In the case of a Ph.D. candidate, no commitment will be made for acceptance of previous study in another graduate school in lieu of required residence until after the candidate has entered into study in residence in the Graduate School. Then the residence units will be determined by the Committee of the Graduate School of Medical Sciences on the basis of a transcript of record and other credentials, but may not exceed those that would be earned under similar circumstances at Cornell University; passing courses or acquiring credit hours is not regarded as evidence satisfactory in itself for transfer of credit. Under any circumstances, the residence credits transferred for graduate work in another school will be limited to a maximum of two units. Study as a candidate or as a special student in an

undergraduate college is not acceptable, even though the courses may be designed for graduate students.

Graduate students who participate in teaching or assist in research qualify for full residence credit if their duties are in the Field of their major subject and do not require more than twenty hours a week. Part-time graduate study for reasons of employment noncontributory to the major Field of study and off campus is not well suited to the biomedical sciences and is not encouraged. However, if permission is granted for part-time study, the student must be in residence at least half-time, in which case the earned residence credit will be in proportion to the time in residence. An additional half unit of residence credit may be earned by registering for and satisfactorily completing an eight-week period of full-time work in summer research. The Committee of the School will not permit anyone to receive credit for more than two units in any period of twelve consecutive months. Eligibility to receive residence units and fractions of units is determined by the Committee of the Graduate School of Medical Sciences.

Graduate students in the Graduate School of Medical Sciences may undertake formal studies or may conduct research on the Ithaca campus. By prior arrangement, such a student registers in the Graduate School at Ithaca and works under an adviser resident at Ithaca who may be appointed as an optional member of the student's Special Committee. This same privilege is available to graduate students from the Ithaca campus who find it desirable to conduct studies at the Graduate School of Medical Sciences.

A candidate for the degree of Ph.D. must complete two of the last four units in successive terms of study at the Graduate School of Medical Sciences or at the Ithaca campus, as noted above.

Each candidate for an advanced degree is expected to complete his study in residence with reasonable continuity. A candidate who fails to register during any period of four or more years is dropped from candidacy and may be readmitted only after the Committee of the Graduate School of Medical Sciences has stipulated the amount of additional residence to be required. No more than seven years may intervene between the time of first registration and the completion of all requirements for a doctorate degree. A student must complete all requirements for the Master's degree in four years.

FOREIGN LANGUAGE REQUIREMENTS

Each Field of instruction has its own foreign language requirements which it considers most useful to that particular

area of study. Any Special Committee may, at its discretion, require knowledge of foreign languages beyond the requirements of the major Field of study. With the approval of his Special Committee, a candidate may satisfy the foreign language requirements by language tests passed at another graduate school in fulfillment of requirements for an advanced degree.

The administration of recommended language examinations is the responsibility of the major Field through the Special Committee. The examinations will be given at times specified by the Special Committee and the results of these examinations will be reported by the major sponsor to the Office of the Graduate School of Medical Sciences.

EXAMINATIONS

For the doctoral degree: A Qualifying Examination and a Final Examination are required for the Ph.D. degree.

(1) The candidate's performance in the Qualifying Examination will enable his Special Committee to determine his fitness to continue with advanced graduate study. The Examination must be given at the end of the second semester of residence. The purpose of the Examination is to test the candidate's progress in his graduate program during the first year as well as his ability to integrate and apply the fundamental aspects of the sciences relevant to the areas of his graduate studies.

The Qualifying Examination, which may be written, oral, or both, is to be administered by the Field of the candidate's major subject in collaboration with his Special Committee. The candidate's major sponsor may select and invite any members of the faculty to assist in the administration of the Examination. The Office of the Graduate School of Medical Sciences is to be advised of the arrangements for the administration of the Examination. A report of the results of the Examination is to be submitted by the major sponsor to the Office of the Graduate School.

(2) The Final Examination must be taken in two parts: *(a)* Examination A, which is oral and written, covers the subject matter of the major and minor Fields. Examination A is to be given not earlier than the last month of the fourth unit of residence and at least four months before the second part, Examination B; *(b)* Examination B is oral and is designed to constitute a defense of the candidate's thesis. Decision that a candidate has passed or failed his Final Examination rests solely with the members of the candidate's Special Committee; however, any member of the faculty of the Graduate School of Medical

Sciences is privileged to attend the oral examinations and to take part in questioning the candidate. Members of the faculty attending the examinations are at liberty to inform the Associate Dean in writing that they disagree with the judgment of the Special Committee and may request review by the Committee of the Graduate School of Medical Sciences of the case in question.

For the Master's degree: A final examination is required for the M.S. degree. This examination covers the candidate's major and minor subjects and is oral and written.

GRADES

Graduate students taking courses in the Graduate School of Medical Sciences must register for each course and take the final examination given in that course or have the office records marked "incomplete." Courses may be audited with the permission of the department head, but no credit will be given.

Credit for graduate work is given only when the candidate does well in both his major and minor Fields of study. Professors having charge of the work of graduate students are required to report grade ratings on all students taking work under their direction to the Office of the Graduate School of Medical Sciences at the end of each semester, or at the close of each academic year. These grade reports are given in the following terms: A (93–100), B (84–92), C (75–83), and F for work unacceptable for credit. Students whose average grade falls below a B may be dropped.

THESES

Research accomplishment presented in the form of a thesis is a principal requirement for both the M.S. and Ph.D. degrees.

Students enrolled for the Master's degree are required to prepare a report on some problem or project undertaken in their major field. In content and form this report must show scholarly attainment.

A candidate for the degree of M.S. or Ph.D. must submit an outline and early draft of the thesis to all members of the Special Committee *at least six weeks* before the Final Examination unless this requirement is modified by the Special Committee.

At least fifteen days before the Final Examination, the candidate shall submit to the Office of the Graduate School of Medical Sciences the typewritten original and one copy (carbon or other approved reproduction) of the thesis, both unbound,

and two copies of an abstract of the doctoral thesis of not more than 600 words. The candidate shall also provide each member of the Special Committee with a typed copy of the thesis which the Committee members may retain until the time of the examination.

The thesis submitted to the Special Committee at least fifteen days before the Final Examination may be modified as a result of the Final Examination, but at the time of the examination, it must be complete in all respects and editorially acceptable for final approval. Subsequent to the Examination the final copies of the thesis, with the signed Thesis Approval form and copies of the endorsed abstract of a doctoral thesis, must be deposited at the Graduate Office on or before the last day for completing requirements and not more than sixty days after the Final Examination.

Doctoral theses must show ability to do critical and independent investigation, must be a contribution to knowledge, and must be presented in a scholarly fashion. They should reflect not only a mastery of a field of research, but the ability to select an important problem for investigation and to deal with it competently. A date for the Final Examination will be set only after the chairman of the student's Special Committee gives written notice to the Office of the Graduate School of Medical Sciences that the thesis is approved.

The facilities of the University Microfilms, Ann Arbor, Michigan, are used to provide for publication of the thesis on microfilm and for the publication of the abstract of the dissertation in the monthly publication entitled *Dissertation Abstracts.*

A copy of the rules and requirements for the submission and the preparation of the thesis may be obtained from the Office of the Graduate School of Medical Sciences. The two copies of the thesis submitted to that office will be bound and deposited in the Medical College Library and in the department where the thesis work was done.

EXPENSES

The fee for the Graduate School of Medical Sciences for the academic year is $1800. This is an inclusive fee with $1514 of the amount apportioned for tuition and the remainder for all accessory items; namely, matriculation, student hospitalization insurance, laboratory charges, graduation fee, microfilming of the doctoral thesis, publishing the abstract in the monthly periodical,

Dissertation Abstracts, mailing the thesis and abstract to and from the microfilm publishers, and binding two copies of the thesis.

Graduate students who have completed the minimum residence requirements and have paid the tuition fees for their degrees may complete their theses in residence. No additional tuition payment will be required, but a registration fee of $286 per academic year will be charged to cover hospitalization insurance, etc.

A graduate student who returns to the Graduate School of Medical Sciences to present his thesis and take the Final Examination for an advanced degree, all other work for that degree having been previously completed, must register as a "Candidate for Degree Only" and pay at that time a fee of $35.

Tuition or other fees may be changed by the Board of Trustees at any time without previous notice.

FINANCIAL ASSISTANCE

Predoctoral fellowships are available to qualified applicants. The fellowships may be renewed yearly providing the academic performance of the fellowship holders is satisfactory. Teaching and research assistantships are available to qualified graduate students in some departments of the Medical College. In addition to a stipend, the costs of tuition and other fees are defrayed for those students receiving financial assistance.

The applicant may obtain information on the available fellowships and assistantships by writing directly to the chairman of the department of his proposed major Field, Cornell University Medical College, 1300 York Avenue, New York, N. Y. 10021, or to the Associate Director of the Sloan-Kettering Division, 425 East 68th Street, New York, N. Y. 10021.

Other predoctoral fellowships are available on a national basis from the National Science Foundation, the National Research Council, and the National Institutes of Health. Information on these fellowships should be requested directly from the appropriate government agency. The Graduate School of Medical Sciences will provide the granting agency with the necessary credentials to support the fellowship application of applicants who qualify for admission to the School.

STUDENT HEALTH SERVICE

Complete ambulatory medical care is provided for all students matriculated in the Graduate School of Medical Sciences through the Personnel Health Service of the Medical Center. Students

matriculating for the first time in the Graduate School are required to have a physical examination by a member of the Health Service staff. In addition each student must report for a chest x ray examination, tuberculin test, and such immunizations as may be considered necessary at periodic intervals. No charge is made for medical care through the Health Service nor for any x rays, laboratory tests, or procedures which may be needed. Each student is required to carry Associated Hospital Service (Blue Cross) hospitalization insurance unless some similar hospitalization insurance is currently in effect through a previous policy. The cost of this insurance for an unmarried student is included in the fee discussed in the section "Expenses." Wives and dependents of students may be covered by the hospitalization insurance policy for a small additional fee. Office hours are held Monday through Friday from 12:30 to 1:30 P.M. by the Student Health staff. All cases of illness must be reported to the Health Service. Students may have in attendance physicians of their own choice, but a reasonable amount of cooperation between such physicians and the College Health Service is expected. Wives and families of students are not eligible for care through the Personnel Health Service but will be referred to appropriate members of the hospital staff for medical care.

SUMMARY OF REGULATIONS FOR GRADUATE STUDENTS

A student contemplating admission to graduate work leading to the M.S. or Ph.D. degree must first obtain the approval of his program from a member of the faculty. If encouraged by the faculty member to proceed, the student may file his application.

When registered for one of these degrees, the candidate should observe carefully the following requirements:

For the Master's Degree

He must –

1. Complete a minimum of two units of work in residence, including a major and one minor course of study.
2. Demonstrate proficiency in one foreign language.
3. Pass a final examination covering his general field of study.
4. Present a thesis approved by the professor representing his major Field of Study and the Committee of the Graduate School of Medical Sciences.
5. Submit two typewritten copies of the thesis, one for filing

in the Medical College Library and the other for the department representing his major Field of study.

For the Ph.D. Degree

He must –

1. Complete six units of training in residence, of which two units of the last four must be taken in successive terms at the Medical College or the Sloan-Kettering Division.
2. Demonstrate proficiency in the foreign languages specified by the major Field of study and/or by his Special Committee.
3. Achieve a high level of scholarly capacity (grade of B or better) and demonstrate the ability and technique necessary for carrying on original work.
4. Complete the following examinations: (1) a Qualifying Examination at the end of the second semester of residence, and (2) the Final Examination (Parts A and B).
5. Present a thesis in the major Field of study, which must represent a contribution to the subject investigated.
6. Prepare an abstract of the approved thesis for publication in *Dissertation Abstracts.*
7. Submit two unbound typewritten copies of the thesis at least fifteen days before Examination B, one for filing in the Medical College Library and the other for the department representing the major Field of study.

RESEARCH SOCIETIES

Sigma Xi, a national honorary society devoted to the encouragement of scientific research, was founded at Cornell University at Ithaca in 1886. An active branch of the Cornell Chapter is maintained at the Medical College. Graduate students are eligible for election to membership in Sigma Xi on the basis of proved ability to carry on original research and on nomination by active members of the Cornell Chapter. Graduate students elected to the society prior to enrolling at Cornell are invited to become active members of the local chapter.

The Cornell University Medical Research Society will hold meetings weekly on Tuesdays, throughout the academic year, beginning October 3, 1967. This informal society offers faculty members of all divisions of the New York Hospital–Cornell Medical Center an opportunity to present papers dealing with original research. Graduate students are invited to attend the meetings and to submit papers for possible presentation.

FIELDS OF INSTRUCTION

The several Fields of instruction of the Graduate School of Medical Sciences are described in the pages that follow. The title of each Field is an approved major or minor subject for candidates for advanced degrees. In addition to these Fields, advanced degree programs are available in certain Fields not separately described. They are: Biostatistics, Cell Biology, Genetics, and Neurobiology and Behavior. Information regarding graduate study in any one of the latter Fields may be obtained through the office of the Graduate School of Medical Sciences.

INSTRUCTION AT THE MEDICAL COLLEGE

Anatomy

Chairman: Professor Roy C. Swan.

Professor: Roy C. Swan.
Associate Professors: Dorothea Bennett, Dana C. Brooks, James L. German III, Wilbur D. Hagamen, John MacLeod, Thomas H. Meikle, Jr., Leonard L. Ross, Julio L. Sirlin.
Assistant Professors: Michael D. Gershon, Myron S. Jacobs, Elsa O'Donnell-Alvelda, Muriel Sackler, George Stassa, Benjamin D. Stinson.
Instructors: Chen Ya Huang, John C. Weber.

Facilities are available for graduate study in various areas of the broad subject of anatomy; in histology, cytology, electron microscopy, neuroanatomy, experimental neurology, male fertility, embryology, and genetics. Students desiring to pursue graduate work in anatomy must have had adequate preliminary training at college level in physics, chemistry, and biology. The specific course requirements for either a major or a minor in the Field of Anatomy will be determined for each candidate after consultation with the authorized representatives of the other departments involved.

COURSES OFFERED

1. GENETICS SEMINAR. Organized on the basis of four semesters in sequence: nucleic acids and genetic fine structure; cytogenetics; differentiation and gene action in higher organisms; genetics of man and medical genetics. Prerequisites: six hours of undergraduate genetics and permission of the instructors.

2. ANATOMY SEMINAR. Two seminars each month are scheduled on selected topics in the broad subject of anatomy including fine structure, development, cell biology, neuroanatomy, and genetics. Senior

members of the anatomy staff and guest speakers will conduct informal discussions on current research in their respective fields.

Biochemistry

Chairman: Professor Alton Meister.

Professors: Alton Meister, Julian R. Rachele.
Associate Professors: Roy W. Bonsnes, William D. Cash, Aaron S. Posner.
Assistant Professors: Esther M. Breslow, Helena Gilder, Julius Golubow, Rudy H. Haschemeyer, S. Steven Hotta, Theodore A. Mahowald, Edward T. Schubert, Daniel Wellner.
Instructor: John D. Termine.

Graduate instruction is offered leading to the Ph.D. or Master's degree. Within the framework of degree requirements and in consultation with the student, the course of study is planned to fit the needs of the individual. Although formal course work is required, emphasis is placed on research. Research opportunities exist in various areas of biochemistry including enzymology, structure and function of proteins and nucleic acids, molecular biology, physical biochemistry, and the intermediary metabolism of amino acids, carbohydrates, nucleic acids, and lipids. Entering graduate students usually work for short periods in several of the laboratories in the Department of Biochemistry before beginning thesis research. Students are encouraged to choose challenging and fundamental research problems that are on the frontiers of biochemistry.

The Department is equipped with virtually all of the instruments and facilities required for modern biochemical research; thus, graduate students are instructed in such methodology as chromatography, counter-current distribution, radioactive and stable isotope techniques, spectrophotometry, electrophoresis, and analytical ultracentrifugation.

Students undertaking graduate study in biochemistry must have a sufficiently comprehensive background in chemistry to pursue the proposed course of study and must present evidence of knowledge of general experimental physics, mathematics (including differential and integral calculus), and general biology. Opportunity is offered to remedy deficiencies in these areas during the first year of graduate study. The Graduate Record Examination (the aptitude test and the advanced test in chemistry) is ordinarily required.

COURSES OFFERED

1. GENERAL BIOCHEMISTRY. This introductory course is designed to provide the student with a knowledge of the fundamentals of biochemistry and an appreciation of the molecular basis of biological phenomena. Instruction includes lectures, demonstrations, assigned readings, reports, and laboratory work on proteins, nucleic acids,

enzymes, carbohydrates, fats, vitamins, hormones, and other compounds of biological importance. Consideration is given to metabolism, genetics, nutrition, and to the application of biochemical and biophysical principles to biological phenomena. First and second trimesters, 1–2 P.M., on Monday, Thursday, and Friday. Third trimester, hours to be arranged on Monday, Wednesday, and Friday.

Graduate students in Biochemistry are required to pass this course (or its equivalent) prior to pursuing advanced courses.

2. TOPICS IN ADVANCED BIOCHEMISTRY. Lectures and conferences in the Department on recent developments in biochemistry. Hours to be arranged.

3. BIOCHEMICAL PREPARATIONS AND TECHNIQUES. Laboratory work dealing with the isolation, synthesis, and analysis of substances of biochemical importance (enzymes, coenzymes, various metabolites, and intermediates), and study of their properties by chemical and physical techniques. Hours to be arranged.

4. ADVANCED GRADUATE BIOCHEMISTRY. The course and the hours when it is given are described in the section "Interdepartmental Courses."

Biomathematics

Please refer to page 36 for complete listing of faculty, description of program, and courses.

Microbiology

Chairman: Professor William F. Scherer.

Professors: William F. Scherer, John Y. Sugg.
Associate Professors: Leonhard Korngold, William M. O'Leary.
Assistant Professors: Robert W. Dickerman, Donald Mackenzie, Elena Ottolenghi, Dieter H. Sussdorf.

Candidates for the Ph.D. degree and postdoctoral fellows can select an area of research interest and activity from such microbiological topics as general and medical bacteriology, microbial chemistry and physiology, microbial genetics, immunology, mycology, and virology.

Prospective students should complete in undergraduate school a minimum of one year (or its equivalent) in general chemistry, organic chemistry, general physics, mathematics including college algebra, botany or zoology (preferably both), and one semester or its equivalent of analytical or quantitative chemistry. General microbiology or bacteriology and calculus are strongly recommended. Students who have not completed the above requirements may be admitted to graduate study on the condition that deficiencies be removed soon after admission.

Courses in graduate work are determined by the student's Special Committee made up of faculty members representing his major and

minor subjects. Included for Ph.D. candidates in Microbiology are the following courses: medical microbiology, microbial chemistry and physiology, advanced immunology, advanced virology, microbial genetics, microbiology seminar, biochemistry, and biostatistics.

The nature and number of other courses depend on the student's minor subjects, his research activities, his individual interests, and the advice of his Special Committee. Such courses at this institution or at near-by universities are available in anatomy, biophysics, cell biology, histology, mycology, parasitology, pathology, pharmacology, physiology, and radiobiology.

COURSES OFFERED

Graduate courses are given during the eleven-week period corresponding to the third trimester of the Medical College curriculum. Lectures are open to all interested persons. Laboratory sessions are generally limited to students taking the course for credit.

1. MICROBIAL CHEMISTRY AND PHYSIOLOGY. Yearly. Two lectures and two laboratory periods weekly. Lectures cover literature and methodology pertinent to physicochemical properties of microorganisms and their environments, the growth and death of microorganisms, chemical composition of cells and subcellular structures, nutritional requirements, microbiological assay and auxotrophic mutants, energy metabolism, degradations and biosyntheses, the physiology of pathogenesis, and important microbial products. Laboratory sessions provide experience with large-scale culture and recovery of cells, synthetic media, microbiological assay, extraction of cellular constituents, respirometry, and studies of substrate utilization employing radioactive metabolites. Minimum prerequisites for credit are general microbiology, qualitative and quantitative analysis, organic chemistry, and at least one semester (or its equivalent) of biochemistry.

2. ADVANCED IMMUNOLOGY. Every second or third year. Two lectures and two laboratory periods weekly. Lectures emphasize current concepts regarding antigen and antibody structure, the physical and biological manifestations of antigen-antibody reactions, and recent developments in studies on the cellular basis of immunity, including antibody formation. The laboratory will cover the isolation, purification, and quantification of antibodies; the critical measurement of antigen-antibody reactions; histological mechanisms during the immune process; and *in vivo* effects of specific antigen-antibody reactions. Minimum prerequisites for credit are introductory immunology (as given in courses in general microbiology) and at least one semester (or its equivalent) of biochemistry. A semester course in histology or microscopic anatomy is desirable.

3. ADVANCED VIROLOGY. Every second or third year. This course presents, in lectures and laboratory sessions, modern concepts and techniques of virology. Virus structure, chemical composition, physical and biologic properties, and relationships with host cells are considered

in depth. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry.

4. MICROBIAL GENETICS. Every second or third year. Two lectures and two laboratory sessions weekly. The lectures deal with genetic systems in fungi, bacteria, and bacterial viruses. Emphasis is placed on those basic concepts of genetics which have been elucidated by the study of microbial systems. Laboratory experiments are designed to demonstrate some of the mechanisms of genetic recombination among microorganisms. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry. A course in general genetics is desirable but not required.

5. MICROBIOLOGY SEMINAR. Scheduled biweekly. Topics in microbiology and infectious diseases are presented in depth by faculty and graduate students of the Department of Microbiology and by visiting scientists from other institutions.

Pathology

Acting Chairman: Professor A. Whitley Branwood.

Professors: John G. Kidd, Robert C. Mellors.
Associate Professors: A. Whitley Branwood, Aaron Kellner, Robert W. McDivitt, George E. Murphy, John F. Seybolt, Richard M. Torack.
Assistant Professors: Carl G. Becker, Margaret H. S. Clements, George F. Gray, Jr., Jack W. C. Hagstrom, C. Richard Minick, William W. Schlaepfer.
Instructor: Carolyn W. Watson.

The Department of Pathology offers a wide opportunity for the experimental study of disease. Adequate animal facilities are available. Most of the current journals and reference books are kept in the departmental library. Autopsies for the entire hospital are performed by members of the Department, and this material, together with specimens in the laboratories of surgical pathology and cytology, offers opportunities for the study of many problems of disease.

Study at the graduate level is oriented toward scientific training in experimental pathology, and special emphasis is placed on a basic training in the fundamental aspects of pathology. By contact with individual staff members, instruction and training is given in immunopathology; neuropathology; basic cellular pathology including electron microscopy, cyto- and histochemistry, cell fractionation and biochemical and biophysical methods; fundamental experimentation with laboratory animals in the study of disease; and gross and microscopic pathology of human tissues and organs.

Candidates will be required, as an initial part of their program, to take the second-year course offered to medical students. The latter part of the graduate's training will be devoted to research in an area of the candidate's choice under the guidance of a senior staff member.

A candidate can qualify for the Ph.D. degree by majoring in experimental pathology. Graduates who do not possess the M.D. degree must have an adequate knowledge of biology, chemistry, mathematics, and physics. The necessary preparation in anatomy, biochemistry, physiology, and biometrics may be obtained at the Medical College as part of the graduate program.

COURSES OFFERED

1. GENERAL AND SYSTEMATIC PATHOLOGY. Lectures, practical classes, and seminars. First and second trimesters.

2. NEUROPATHOLOGY. Lectures, practical classes, and seminars. Third trimester.

Prerequisites for the above courses are as in the general description.

Pharmacology

Chairman: Professor Walter F. Riker, Jr.

Professors: Walter F. Riker, Jr., Walter Modell.
Associate Professors: Amir Askari, Jack Peter Green, Raymond W. Houde.
Assistant Professors: William T. Beaver, Wah-Yip Chan, Roberto Levi, Barrie Levitt, Michiko Okamoto.
Instructor: Arthur Raines.

Facilities are available for advanced work and research in the chemical, pharmacodynamic, and clinical aspects of pharmacology. Special opportunities are afforded for work in general pharmacology, neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and drug evaluation in man. The Department of Pharmacology is well equipped with specialized apparatus for electrophysiological and biochemical techniques.

In graduate training, emphasis is placed on a sound basic training in general pharmacology. By means of individual instruction, the candidate is later afforded an exposure to several specialized aspects of pharmacology. The latter part of the graduate curriculum is devoted to research in an area of the candidate's choice.

An adequate preliminary training in organic chemistry, physical chemistry, biochemistry, and physiology is prerequisite to graduate work in pharmacology. Training in statistics is strongly recommended.

COURSES OFFERED

1. GENERAL PHARMACOLOGY. The basic pharmacology course as offered to second-year medical students is open to graduate students. The course consists of lectures, laboratory work, demonstrations, and seminars given during the first and second trimesters. The purpose of

these exercises is to teach the principles of pharmacology. Detailed consideration is given to the parameters of drug action so as to provide the student with the fundamental concepts essential for the evaluation of any drug. Consequently, emphasis is placed on the scientific basis of pharmacology. Prototype drugs, considered essentially systemically, serve to illustrate several mechanisms and parameters of drug action. Therapeutic applications are considered only insofar as they illustrate principles of pharmacology or drug hazards. 154 hours. Prerequisites: biochemistry and physiology.

2. INTRODUCTION TO CHEMICAL BIOLOGY. A survey of some physicochemical and biochemical aspects of the interactions of drugs with living systems will be presented in weekly lectures of two hours each during the second semester of the academic year. The following subjects will be presented: (1) *The Nature of drug-biophase interaction.* Includes a discussion of the properties of drugs as electrolytes, the binding of drugs by polyelectrolytes and other substances, the passage of drugs from the aqueous phase into the cell, and the effects of drugs on the properties of the interface between the aqueous and biophase. (2) *The kinetics of the drug-biophase interaction.* Includes a review of chemical kinetics, the application of chemical kinetics to the reactions of drugs with living systems, and an evaluation of receptor theory. (3) *The relationships between chemical structure and biological activity.* Presented with special emphasis on those steric and electronic properties of biologically active substances that provide inferential evidence of the structure and configuration of the biological locus of action, e.g., the receptor enzyme. (4) *The modification of cell metabolism by drugs.* Describes the metabolic effects of selected drugs and critically analyzes the relationship between their metabolic and pharmacologic effects. (5) *The modification of drugs by cell metabolism.* Embraces all mechanisms of biotransformation and discusses the relevance of drug metabolism to pharmacologic action. Prerequisites: physical chemistry, organic chemistry, biochemistry, and pharmacology.

3. PHYSIOLOGY AND PHARMACOLOGY OF JUNCTIONAL TRANSMISSION. Offered in the third trimester. In a series of two one-hour sessions per week, consideration will be given to the following: *(a)* current concepts of junctional transmission; *(b)* influence of certain drugs on junctional transmission; *(c)* the significance of pharmacologic analysis for revision of current concepts of junctional transmission; *(d)* the role of the motor nerve terminal in the physiology and pharmacology of junctional transmission; *(e)* trophic influences of nerve.

4. RESEARCH IN PHARMACOLOGY. Research opportunities may be arranged throughout the year for graduate students who are not majoring in pharmacology but who wish some investigative experience in the discipline. Special opportunities are offered for work on the nervous and cardiovascular systems and in biochemical aspects of pharmacology.

Physiology and Biophysics

Chairman: Professor Robert F. Pitts.*

Acting Chairman: Professor Roger L. Greif.
Professors: Robert F. Pitts, Gerhard H. Giebisch, Roger L. Greif.
Associate Professors: Harold G. Hempling, Richard H. Kessler, Erich H. Windhager.
Assistant Professors: Sulamita Balagura, Colin Fell, Lou Ann Pilkington.

Opportunities are offered for graduate study toward a Ph.D. degree and for postdoctoral research training in limited areas of Physiology and Biophysics, including the physiology of the circulatory system, endocrine organs, and kidney, and the biophysics of membrane transport. The laboratory is well equipped for both chemical and physical studies on living animals. The staff has special competence in areas of acid-base regulation; the renal tubular transport of ions employing micropuncture techniques; the transport of ions, water, and organic metabolites in uniform cell populations; the mode of action of thyroid hormones; the metabolism of the kidney; and the distribution of blood flow to organs in circulatory shock. Postdoctoral fellows are accepted for one or two years of closely supervised research experience under the direction of a member of the staff. A few selected graduate students are prepared for a career in teaching and research in physiology and biophysics through recommended course work, participation in seminars, and closely supervised research leading toward the preparation of a satisfactory thesis. Adequate training in chemistry, physics, mathematics, and biology is prerequisite to graduate study. Graduate students with majors in other departments may elect physiology as a minor provided that they have obtained adequate background in general mammalian anatomy, neuroanatomy, and histology.

COURSE OFFERED

1. TOPICS IN BIOPHYSICS. Offered in the second trimester. In a series of weekly sessions of one to two hours, several areas in which concepts derived from chemistry and physics have influenced biological thought will be reviewed and analyzed. The choice of topics will depend, in part, on the interests of the students. Previous topics have included: membrane physiology and biophysics, biological reaction rates, topics in irreversible thermodynamics. Where appropriate, demonstrations or laboratory exercises will be included. Prerequisites: physics, physical chemistry, differential and integral calculus.

* On sabbatical leave (1967–68).

Public Health (Microbiology, Epidemiology, and Virology)

Chairman: Professor Walsh McDermott.

Professors: Walsh McDermott, Edwin D. Kilbourne.
Associate Professors: Kenneth G. Johnson, Jerome L. Schulman.
Assistant Professor: Katsuhiko Yano.

The University does not grant a Master's degree or a doctorate in public health; however, a graduate degree (Ph.D.) may be obtained in the Department of Public Health of the Medical College in certain of the related medical sciences. Microbiology, with particular emphasis on virology and mycobacterial infections, is an area of special interest in the Department. Advanced training and research are conducted in this area and include studies of influenza virus genetics, experimental (viral) epidemiology, host determinants of viral virulence, and experimental chemotherapy. Studies and research in human epidemiology are also conducted in the Department. No formal courses of instruction are offered, but informal staff seminars in virology are held weekly.

DIVISION OF BIOMATHEMATICS

The Field of Biomathematics is supported jointly by the Medical College and the Sloan-Kettering Division.

Biomathematics

Professor: Sol I. Rubinow.

Visiting Professors: Hirsh G. Cohen, Joel L. Lebowitz.
Visiting Associate Professors: Betty J. Flehinger, Richard P. Kelisky.
Assistant Professors: Evelyn F. Keller, Tai Te Wu.
Research Associate: Bruce W. Knight.
Research Fellow: Daniel A. Bloch.

The Division of Biomathematics offers a wide range of opportunities for the development of quantitative methods in the biological and medical sciences, with special emphasis on the application of mathematics and the utilization of automatic computers. Graduate study programs leading to advanced degrees in the Fields of Biomathematics and Biostatistics are available to students whose primary interests are mathematical, but who wish to concentrate on biological or medical applications.

Graduate students in the Field of Biomathematics are required to obtain thorough training in linear algebra, complex variables, and partial differential equations and boundary value problems. Students in the Field of Biostatistics are required to obtain thorough training in

probability theory and fundamentals of statistical inference. In addition to other courses, an appropriate plan of study in the relevant aspects of biology, chemistry, physics, and medicine will be made to suit the particular area of application of the individual student. Some typical research areas in Biomathematics are biological and chemical kinetics, biophysics, molecular biology, and physiological systems. Some typical research areas in Biostatistics are differential diagnosis, nerve impulse transmission, planning of clinical trials, storage and retrieval of medical information, and surveillance programs.

Special opportunities are also available for research at the postdoctoral level. While postdoctoral fellows should have a high degree of competence in the basic skills of biomathematics or biostatistics, they need not necessarily be professional mathematicians.

COURSES OFFERED

1. INTRODUCTORY BIOMATHEMATICS, I and II. The purpose is to introduce the student to the use of elementary mathematics in various areas of medicine and biology. Topics vary from year to year. Those to be covered this year are the following: I. (First trimester.) Normal distribution, homeostasis, kinetic reactions, counter-current distributions. II. (Second trimester.) Compartment analysis, sedimentation, chromatography, biological rhythms, blood flow. No prerequisite required.

2. BIOMATHEMATICS SEMINAR. Presentation of research investigations by the staff, as well as student reports on various topics chosen from the current literature. Required of biomathematics majors.

3. STATISTICAL INFERENCE AND DECISIONS IN MEDICINE. A survey of statistical methods useful in planning medical experiments and drawing conclusions from observed data.

4. BIOSTATISTICS SEMINAR. Reports and discussion by the staff and other investigators on statistical methods utilized in the collection, analysis, and interpretation of biological data. Required of biostatistics majors.

INTERDEPARTMENTAL COURSES

ADVANCED GRADUATE BIOCHEMISTRY. A graduate course in biochemistry is offered jointly by the faculties of the Sloan-Kettering Division and the Medical College over a two-year period. In each trimester, eleven two-hour lectures are given at a rate of one a week. It is not essential that students take the course in any particular sequence. The course includes consideration at an advanced level of the following subjects, with particular attention to contributions of recent research: *1967–68:* Trimester 1, chemistry of proteins; Trimester 2, chemistry of nucleic acids; Trimester 3, physical methods in biochemistry. *1968–69:* Trimester 1, enzymology; Trimester 2, carbohydrates, lipids, and hormones; Trimester 3, physical methods in biochemistry.

GENETICS SEMINAR. An advanced seminar in genetics is offered each semester by the faculties of the Medical College and the Sloan-Kettering Division. The seminar consists of one two-hour session a week for four semesters in accordance with the following schedule: *Fall semester, 1967:* Developmental Genetics. Gene action and the control of differentiation in higher organisms, sex determination, genetic control of metabolism. *Spring semester, 1968:* Genetics of Man and Medical Genetics. Populations and families, statistical methods and study design in human genetics, study of human variation, clinical genetics. *Fall semester, 1968:* Biochemical and Molecular Genetics. The biochemical nature of the hereditary material, recombination analysis of genetic fine structure, mechanisms of gene action in microorganisms. *Spring semester, 1969:* Cytogenetics, DNA and chromosome duplication, mechanisms of gene action as related to chromosome structure, genetics of somatic cells.

Six or more university-credit hours in genetics, or attendance at the lectures pertaining to genetics given in the Department of Anatomy, and the instructor's permission are required for admission. Two semesters are required for a minor in Genetics, and all four semesters are required for a major in Genetics.

INSTRUCTION AT THE SLOAN-KETTERING DIVISION

Frank L. Horsfall, Jr., Director
Liebe F. Cavalieri, Associate Director

GRADUATE SEMINAR. The weekly graduate seminar is offered each year and is attended by all graduate students of the Division. The subjects covered vary from year to year, but in general they deal with problems of modern biology. Two or three topics are selected for discussion each year, and an attempt is made to rotate the subjects on a three-year cycle. Topics are usually chosen from the following: nucleic acid and protein chemistry and biochemistry; chromosome structure and function; special topics in bacterial genetics; regulation; radiobiology; mammalian and bacterial viruses. The discussion is carried principally by graduate students under the guidance of faculty members whose area of specialization coincides with the topic. From time to time outstanding authorities on the subject are invited as guest speakers.

SPECIAL TOPICS COURSE. The Special Topics course covers subjects similar to those of the Graduate Seminar and consists of lectures given by faculty members or guest lecturers, or both. The subject matter varies from year to year. A student is expected to take this course for two years and to audit it during the remaining years, as he will be responsible for the material in Final Examination A.

Biochemistry

Chairman: Professor Martin Sonenberg.

Professors: M. Earl Balis, Aaron Bendich, Oscar Bodansky, George B. Brown, Liebe F. Cavalieri, Jack J. Fox, Mary L. Petermann, Martin Sonenberg, C. Chester Stock.
Associate Professors: Ralph K. Barclay, Saul Green, Morton K. Schwartz.
Assistant Professors: Ellen Borenfreund, John D. Fissekis, Alfredo Giner-Sorolla, Mary G. Hamilton, Dietrich Hoffman, Willi Kreis, Jerome S. Nisselbaum, James C. Parham II, Barbara H. Rosenberg, Josephine S. Salser, Vladimir P. Skipski.
Instructors: Robert J. Cushley, Norbert I. Swislocki.

Opportunities are available for advanced work and research in chemistry and metabolism, bio-organic chemistry, enzymology, hormone chemistry and action, and molecular biology.

Undergraduate requirements for a major in Biochemistry include courses in inorganic chemistry, qualitative chemistry, quantitative chemistry, organic chemistry, physical chemistry, physics (mechanics, electricity, and magnetism, and sound, heat, light), biochemistry and mathematics (through calculus). If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study. Furthermore, while the Graduate Record Examination is not generally required of applicants, those applicants who are not within the top third of their graduating class are urged strongly to support their applications with scores attained on the Graduate Record Examination in both the aptitude test (verbal and quantitative) and the advanced test in chemistry.

Students electing biochemistry as a major or minor subject must complete the Medical College course in biochemistry, or its equivalent, as a minimum requirement.

In addition, students who major in Biochemistry must complete five trimesters, and those who minor, three trimesters, of the course Advanced Graduate Biochemistry.

COURSES OFFERED

ADVANCED GRADUATE BIOCHEMISTRY. The course and the hours when it is given are described on page 37 under "Interdepartmental Courses."

Biology

Chairman: Professor Frederick S. Philips.

Professors: Frank W. Foote, Jr. (Pathology), Frank L. Horsfall, Jr., (Microbiology), Frederick S. Philips (Pharmacology).
Associate Professors: Edward A. Boyse, Etienne de Harven, Jørgen E. Fogh (Microbiology), Peter J. Gomatos (Microbiology), Dorris J.

Hutchison (Microbiology), Leopold G. Koss (Pathology), Alice E. Moore, Lloyd J. Old, H. Christine Reilly (Microbiology), Herbert S. Schwartz (Pharmacology), Stephen S. Sternberg (Pathology), Leo Wade (Preventive Medicine), Ernest L. Wynder (Preventive Medicine).

Assistant Professors: June L. Biedler, Edward S. Essner, Wilbur F. Noyes III, Herbert F. Oettgen, Francis M. Sirotnak (Microbiology), Bernard Tandler, Morris N. Teller.

Instructors: Alberta M. Albrecht, James G. Cappuccino, Elaine G. Diacumakos, George Sichuk.

The program in Biology is oriented toward an understanding of factors which initiate, control, and modify growth and biological development. Opportunity is offered for advanced work and research in cytology, genetics, virology, immunology, microbiology, endocrinology, and pharmacology.

Undergraduate prerequisites for a major in Biology include courses in inorganic chemistry, organic chemistry, qualitative and quantitative chemistry, physical chemistry, physics (mechanics, electricity, and magnetism; sound, heat, and light), mathematics (through calculus), and general biology or zoology or botany. If any of these requirements are not completed at the undergraduate level, they must be completed during the first year of graduate study.

Programs are determined individually on the basis of interest, training, and prior experience. Elective courses in basic medical sciences include those described for the Medical College. Formal graduate courses, seminars, and tutorials are arranged with the faculties of the Sloan-Kettering Division and the Medical College.

COURSES OFFERED

1. CYTOLOGY. A formal course in general animal cytology. The topics include cell theory, principles of light and electron microscopy, mitosis, cytogenetics, cellular fine structure, biochemical analysis and enzymology of organelles isolated by differential centrifugation, cytopathology, and cytology of cancer cells and tissue cultures.

2. VIROLOGY. A formal course in which major emphasis will be placed on the basic mechanisms in the biology of animal viruses. The topics to be considered include virus structure and composition; assay of viruses and viral-specific products; interaction of viruses with receptors and antibodies; syntheses of viral nucleic acids and proteins and assembly of viral particles; structural and functional alterations in viral-infected cells; pathogenesis of viral diseases; and viral genetics.

3. TUMORIGENESIS. A series of lectures dealing with carcinogenesis and related subjects. Topics include the nature of neoplastic changes *in vivo* and *in vitro;* comparison of chemicals, viruses, and physical agents; metabolism and mechanism of action of chemical carcinogens; and genetic, hormonal, and immunological factors involved in carcinogenesis.

4. GENETICS SEMINAR. The course is described on page 38 in the section, "Interdepartmental Courses."

5. IMMUNOLOGY. A series of formal lectures in immunology, with special reference to immunobiology. Topics dealt with include immunological techniques, structure of antibodies, complement, immediate and delayed hypersensitivity, cellular basis of immune responses, ontogeny and phylogeny of the immune response, autoimmunity, immunological tolerance, immunogenetics, homotransplantation and tumor immunology.

Biomathematics

Please refer to page 36 for complete listing of faculty, description of program, and courses.

Biophysics

Chairman: Professor Edward R. Epp.

Professor: John S. Laughlin.
Associate Professors: Edward R. Epp, Helen Q. Woodard.
Assistant Professors: Karin R. Corey, Jae Ho Kim, Harold Moroson, Ira Pullman, Louis Zeitz.
Instructors: Jerrold Fried, Peter J. Kenny.

Graduate work is offered leading to the Ph.D. degree in Biophysics and the M.S. in radiation physics.

Undergraduate prerequisites include courses in general physics, electricity and magnetism, mechanics, mathematics (through calculus), and thermodynamics, and acceptable laboratory experience in these subjects. If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study.

Some of the research projects in Biophysics which are pertinent to the Ph.D. program include: studies of the metabolism of various isotope-labeled compounds in man; metabolism of biologically important compounds in tissue cultures of human tumor cells, in bacteria, and in viruses; the mechanism of radiation action on bacteria, phage, yeast, and small animals, including metabolic studies with human and other tumors influenced by radiation under different environmental conditions; fundamental radiobiological studies of mammalian cells in tissue culture, using synchronized cell populations and metabolic inhibitors; trace element analysis of tissue sections by means of fluorescent x ray spectrometers; electron spin resonance spectroscopy of free radicals in carcinogenic and irradiated compounds; study of the early radiation-induced processes in cells using high-intensity pulsed irradiation techniques; the investigation, using existing computer facilities, of mathematical models which simulate the behavior of biological systems, e.g., the proliferation of cells in human leukemia, the measurement of radiation by calorimetric, chemical, and solid-state techniques.

The course of study leading to the M.S. degree in radiation physics trains physicists in the various aspects of production, measurement, and application of radiation to various medical and biological problems. These problems particularly involve the use of radiation in the diagnosis and treatment of cancer. A variety of radiation sources are available, capable of generating photons and electrons with energies ranging from 5 Kev to 25 Mev and with electron dose-rates up to 10^{14} rads per second. Experience is also provided in the handling and use of many different radioisotopes. The magnitude and variety of facilities and unique radiation projects at the Sloan-Kettering Institute and the Memorial Hospital are particularly pertinent for training in this area. An important feature is the coexistence of fundamental research and practical and clinical applications in the same center.

COURSES OFFERED

1. RADIOLOGICAL PHYSICS. Lectures and problems. A series of hourly lectures and assigned problems in applied mathematics, fundamentals of radiation physics, x ray and radium treatment planning, diagnostic x ray principles, radiation protection, and uses of radioactive isotopes.

2. RADIOBIOLOGY. A full-year course in fundamental radiobiology dealing with the effects of radiation on cells, viruses and on macromolecules, as well as on whole animals. The course also covers areas of radiation physics and radiation chemistry pertinent to radiobiology.

3. ADVANCED BIOPHYSICS. Laboratory courses in each of the topics of radiation biophysics.

4. BIOPHYSICS COLLOQUIA. Reports on research in progress by faculty and outside lecturers; required for majors in Biophysics.

REGISTER OF STUDENTS

DOCTORS OF PHILOSOPHY

Lorraine S. Abrash, A.B. 1955; Ph.D. 1966, Cornell University. Major: Biochemistry. West Englewood, N.J.

Roberta M. Bruck, B.A. 1957, Douglass College; M.A. 1962, Columbia University; Ph.D. 1967, Cornell University. Major: Anatomy. Highland Park, N.J.

Jo Anne Munigle, B.A. 1957, Connecticut College; Ph.D. 1967, Cornell University. Major: Anatomy. West Hartford, Conn.

Arnoldo K. Ventura, B.Sc. 1961, University College of the West Indies; Ph.D. 1967, Cornell University. Major: Microbiology. Jamaica, B.W.I.

MASTER OF SCIENCE

John W. Henke, Jr., B.S. 1963, Eastern Michigan University; M.S. 1967, Cornell University. Major: Radiological Physics. East Detroit, Mich.

CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Fran Auerbach, B.S. 1965, Cornell University. Major: Microbiology. Huntington Station, N.Y.

Gary Citrin, B.S. 1963, Brooklyn College of Pharmacy. Major: Pharmacology. Brooklyn, N.Y.

Aristides Costeas, B.Sc. 1958, University of Athens; M.A. 1964, Columbia University. Major: Biophysics. Elmhurst, N.Y.

Augustus C. Damian, Jr., A.A. 1958, Silliman University; M.D. 1963, University of the Philippines. Major: Physiology. Quezon City, P.I.

Joseph DiSalvo, B.A. 1966, New York University. Major: Physiology. Brooklyn, N.Y.

Robert A. Erlandson, B.A. 1959, New York University; M.S. 1963, Long Island University. Major: Cytology. Woodside, N.Y.

Anastasia Gregoriades, B.A. 1962; M.A. 1964, Hunter College. Major: Biology. New York, N.Y.

Edwin C. Hahn III, B.A. 1958, Amherst College. Major: Microbiology. Scarsdale, N.Y.

Joyce M. Howell, B.S. 1966, Virginia Polytechnic Institute. Major: Anatomy. Vinton, Va.

June E. Kaiser, B.S. 1965, Cornell University. Major: Microbiology. Locust Valley, N.Y.

Harriet R. Levie, A.B. 1960, Barnard College; M.A. 1964, Hunter College. Major: Biochemistry. New York, N.Y.

Gesina L. Longenecker, B.S. 1965, Newcomb College. Major: Pharmacology. New Orleans, La.

Neal A. Machtiger, B.S. 1966, Cornell University. Major: Microbiology. Valley Stream, N.Y.

Stephen Margolis, B.A. 1963, Yeshiva University. Major: Pharmacology. New York, N.Y.

Anne G. Mazelis, B.S. 1962, The College of the City of New York; M.S. 1964, University of Chicago. Major: Biochemistry. New York, N.Y.

Arthur Myles, B.A. 1960, Middlebury College; M.A. 1962, Wesleyan University. Major: Biochemistry. Yonkers, N.Y.

Margaret R. Payne, B.S. 1964, Medical College of Virginia School of Pharmacy. Major: Biochemistry. Richmond, Va.

Jeanne I. Rader, B.A. 1966, Syracuse University. Major: Biology. Hamburg, N.Y.

Charles S. Rubin, B.S. 1965, University of Scranton. Major: Biochemistry. Scranton, Pa.

Meryl S. Rubin, B.S. 1960, The College of the City of New York. Major: Biochemistry. New York, N.Y.

Arthur G. Rudin, A.B. 1965, Cornell University. Major: Pharmacology. Rockaway Park, N.Y.

Priscilla A. Schaffer, B.S. 1964, William Smith College. Major: Microbiology. Erie, Pa.

Irene A. Skipski, A.B. 1955, Temple University. Major: Biochemistry. New York, N.Y.

David Soifer, B.S. 1961, Columbia University. Major: Anatomy. New York, N.Y.

Lloyd M. Stempel, B.S. 1956, The College of the City of New York. Major: Biochemistry. Brooklyn, N.Y.

Elizabeth B. Thompson, B.A. 1964, Radcliffe College. Major: Anatomy. Newark, N.J.

Barbara K. Urbaitis, B.A. 1960, Hunter College. Major: Physiology. New York, N.Y.

Ramah Weisblum, B.A. 1959, Barnard College; M.S. 1964, New York University. Major: Biology. New York, N.Y.

Sarah S. Winans, A.B. 1963, Cornell University. Major: Anatomy. Murray Hill, N.J.

Marion M. Zatz, A.B. 1965, Barnard College. Major: Microbiology. New York, N.Y.

CANDIDATE FOR THE DEGREE OF MASTER OF SCIENCE

Anna B. Drakontides, B.A. 1955; M.A. 1960, Hunter College. Major: Anatomy. New York, N.Y.

STUDENTS ENTERING IN JULY 1967

William F. Bowers, B.A. 1966, University of California (Berkeley). Major: Biochemistry. Boston, Mass.

Mona M. Dickson, B.S. 1966, Massachusetts Institute of Technology. Major: Biochemistry. College Park, Md.

Jerald D. Gass, B.S. 1957, University of Oklahoma; A.M. 1962, Harvard University. Major: Biochemistry. Oklahoma City, Okla.

Melvin B. Hayes, B.A. 1964, Washington and Jefferson College. Major: Biochemistry. Dunns Station, Pa.

Bernard Horowitz, B.S. 1966, University of Chicago. Major: Biochemistry. Philadelphia, Pa.

Louise A. Lichtenberg, B.A. 1964, Oberlin College. Major: Biochemistry. Washington, D.C.

Lawrence M. Pinkus, B.A. 1966, Johns Hopkins University. Major: Biochemistry. Mohegan Lake, N.Y.

Roberta E. Weisbrod, B.S. 1964, Brooklyn College. Major: Biochemistry. Brooklyn, N.Y.

Peter O. Zelazo, B.A. 1965, Queens College. Major: Biochemistry. Kew Gardens, N.Y.

STUDENTS ENTERING IN SEPTEMBER 1967

Janet K. Armstrong, B.A. 1967, New York University. Major: Microbiology. Fraser, Mich.

Dianne D. Aronian, B.S. 1962, Westminster College. Major: Genetics. New York, N.Y.

Richard W. Avenia, B.S. 1967, St. John's University. Major: Biochemistry. Valley Stream, N.Y.

Margaret E. Barnard, B.Sc. 1967, Dalhousie University. Major: Biology. Dartmouth, Nova Scotia

Constance Blaser, B.S. 1967, Cornell University. Major: Microbiology. Flushing, N.Y.

Margaret S. Chen, B.S. 1965, National Taiwan University. Major: Virology. Taipei, Taiwan

Sister Ellen Marie Duffy, A.A. 1958, Mercy College; B.A. 1959, Manhattanville College; M.S. 1962, Catholic University of America. Major: Biochemistry. Dobbs Ferry, N.Y.

Janet L. Duyckinck, B.S. 1967, Bucknell University. Major: Biology. Clark, N.J.

Ellen D. Heller, B.A. 1967, Russell Sage College. Major: Anatomy. Hillside, N.J.

Michael T. Huber, B.S. 1965; M.S. 1967, Miami University. Major: Biochemistry. Mt. Healthy, Ohio

Peter B. Jahrling, A.B. 1967, Cornell University. Major: Microbiology. Ridgewood, N.J.

Laura D. Kramer, B.A. 1967, University of Pennsylvania. Major: Microbiology. Muttontown, N.Y.

Robert C. Nowinski, B.S. 1967, Beloit College. Major: Biology. New Rochelle, N.Y.

Ismail Parsa, B.S. 1957; M.D. 1961, University of Geneva. Major: Biochemistry. Brooklyn, N.Y.

Judith D. Pilszynski, B.A. 1967, Albertus Magnus College. Major: Biochemistry. Elmhurst, N.Y.

Lorraine A. Plati, B.S. 1967, Jackson College. Major: Anatomy. Rutherford, N.J.

Paul G. Richman, B.S. 1967, Brooklyn College. Major: Biochemistry. Brooklyn, N.Y.

Prakash V. Sulakhe, B.Sc. 1962; M.Sc. 1965, Bombay University. Major: Biochemistry. Bombay, India

John Sweeney, B.S. 1967, Manhattan College. Major: Pharmacology. Brooklyn, N.Y.

Jeffrey Urman, B.S. 1967, University of Connecticut. Major: Pharmacology. Stamford, Conn.

Donald H. Waters, B.S. 1967, Philadelphia College of Pharmacy and Science. Major: Pharmacology. E. Brunswick, N.J.

Anne B. Wolin, B.A. 1966, Douglass College. Major: Microbiology. Linden, N.J.

STUDENT ENTERING IN FEBRUARY 1968

Nancy J. Chew, B.A. 1963, University of North Carolina. Major: Biochemistry. Tallahassee, Fla.

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